

Amendments to the Specification:

Please replace the paragraph beginning at page 6, line 27, with the following amended paragraph:

Junction – A point of connection of two or more fibers to one another. Examples of junctions can be seen in ~~Fig. 2~~ Figs. 2A-2F (please refer to the description below relating to this figure).

Please replace the paragraph beginning at page 13, line 25 and ending at page 14, line 7, with the following amended paragraph:

The geometry of the network is defined by the fibers. In formation of the network the chemical complementary and molecular recognition properties may be utilized by employing a self-assembly process. The fibers may be assembled to form the network by sequence-specific interactions of the nucleotide chain with complementary sequences. This may be used for the formation of various junctions (e.g. T- or X- junctions, as exemplified in ~~Fig. 2~~ Figs. 2A-2F and others). Specific molecular recognition between nucleic acid chains and linkers or complexing agents (the linkers or complexing agents may be oligo-nucleotides or a variety of other molecules, macromolecules, supramolecular assemblies or particles) may be used to link the nucleic acid chains to interface components or to other network components, e.g. to particles situated at junctions between fibers.

Please replace the section beginning at page 18, line 13, and ending at page 19, line 3, with the following amended section.

~~Fig. 1A shows~~ Figs. 1A-1B show a matrix of interface components and linkers for binding to the network of the invention on the one hand and ~~connect~~ connecting to external electronic circuitry or components on the other hand.

~~Fig. 1B~~ Fig. 1C illustrates an embodiment of immobilization of oligo-nucleotide linkers onto the interface components.

~~Fig. 2 shows~~ Figs. 2A-2F show six examples of junctions between nucleic acid chains (~~six examples are shown in Figs. 2A-2F, which are explained in the text below~~).

~~Fig. 3A is a presentation of~~ Figs. 3A-3B represent the manner of forming and functionalizing a nucleic acid chain into a wire, with the conducting material being silver (the wire's skeleton consists of nucleotides).

~~Fig. 3B~~ Fig. 3C shows a possible current-voltage relationship of a wire formed as illustrated in Fig. 3A Figs. 3A-3B, which is dependent on the voltage scanning direction (presented by arrows on the curves).

~~Fig. 4 is a representation of~~ Figs. 4A-4B represent the manner of forming a wire on a nucleotide skeleton, where the electronic material is polyphenylene vinylene (PPV).

~~Fig. 5 shows~~ Figs. 5A-5E show a number of examples of functionalized nucleotide chains consisting of a p/n junction (Figs. 5A-5C), a graded p/n junction (Fig. 5D) and a bipolar n-p-n transistor (Fig. 5E).

Please replace the paragraph beginning at page 19, line 6, with the following amended paragraph.

~~Fig. 7 is an illustration~~ Figs. 7A-7B are illustrations of a molecular switch in accordance with an embodiment of the invention.

Please replace the section beginning at page 20, line 19 and ending at page 21, line 10, with the following amended section.

The formation of a network typically begins by providing a matrix of interface components, which provide the I/O interface between the network and an external circuitry or external component. Illustration of one embodiment of such an interface component matrix **100** is shown in ~~Fig. 1A~~ Figs. 1A-1B. Each of the interface components **102** is typically a metal electrode having a network-connecting pad **104**, and an external circuitry connecting pad **106** linked by a connector portion **108**.

As a preparatory step for the formation of the network, the connecting pads are treated to allow binding thereto of linkers **110**, e.g. derivatized oligonucleotides, as shown in Fig. 1B. Examples of the manner of treatments are described below. (One embodiment of the manner of immobilizing a linker oligonucleotide onto an interface component is seen in ~~Fig. 1B~~ Fig. 1C and described below). Pre-prepared linkers **110** can then be attached to the pad **104**, typically a different linker to each of the pads. The linkers **110**, shown in a schematical manner in the enlargement at the right of the central portion **112** of the matrix, may be immobilized onto pads **104**, for example, by jet printing, e.g. in the manner described below in the Examples. In this manner, a different linker **110** may be attached to each of pads **104**. Each of linkers **110** may have a selective binding ability to a different specific

nucleic acid sequence, this feature being represented by the different shapes at the end of the linkers.

Please replace the paragraph beginning at page 22, line 1, with the following amended paragraph.

~~Fig. 1B~~ Fig. 1C is a schematic representation of one embodiment for immobilizing an oligonucleotide onto an interface component. Biotin molecules **120** and **122** are bound, one to an oligonucleotide **124** and the other to a sulfur containing moiety **126**. Biotin molecule **122** is immobilized onto interface component **128** through the sulfur containing moiety **126** and then when streptavidin molecules **130** are introduced into the medium, they yield the formation of a complexing agent **132**, which is a supramolecular complex comprising biotin and streptavidin, which immobilizes oligonucleotide **124** onto interface component **128**.

Please replace the paragraph beginning at page 22, line 14, with the following amended paragraph.

Important components in the network of the invention are junctions which serve a variety of functions. Several examples of junctions are shown in ~~Fig. 2~~ Figs. 2A-2F. Fig. 2A depicts a junction **200**, formed between two single-stranded nucleic acid fibers **202** and **204**. The junction, in this specific example is formed by hybridization of a terminal end sequence **206** in fiber **204** and a complementary sequence **208** in fiber **202**. This junction may serve as a T-type junction between nucleic acid fibers which can then be transformed into functionalized connecting junctions by depositing an electrically conducting substance on fibers **202** and **204** and junctions, e.g. in the manner to be described below.

Please replace the paragraph beginning at page 23, line 10, with the following amended paragraph.

A specific example of such a complex molecular structure is shown in ~~Fig. 1B~~ Fig. 1C (above). Although this complex molecular structure, which is a biotin-streptavidin complex, is shown in its role as immobilizing oligonucleotide onto an electrode, the same complex molecular structure may also be used for forming a junction between nucleic acid

fibers (i.e. each fiber will be modified by binding a biotin and then the two avidin moieties may be complexed by one streptavidin).

Please replace the paragraph beginning at page 24, line 9, with the following amended paragraph.

Reference is now being made to ~~Fig. 3A~~ Figs. 3A-3B, showing the manner of formation of a wire in accordance with an embodiment of the invention which in this specific case is a wire formed on a nucleotide skeleton. ~~The As illustrated in Fig. 3A, the~~ wire here is formed between two electrodes 300, typically made of, or coated by metals such as gold, platinum, silver, etc. Electrodes 300, which may be first treated in a manner to facilitate subsequent binding of the linker, are wetted separately with a solution containing either linker molecules 302 or 304, each consisting of a single-stranded oligonucleotide ("*Oligo A*" and "*Oligo B*", respectively), derivatized by a disulfide group. When these linkers are deposited on electrodes 300, under appropriate conditions, the disulfide group bind to the electrodes 300, to form linkers 306 and 308, respectively (step (a)). Electrodes 300 are then wetted with a nucleotide chain solution, e.g. a DNA double-stranded fiber, 310, having sticky ends, complementary to the sequences of the oligonucleotides in linkers 306 and 308. Electrodes 300 are spaced from one another at a distance about equal to the length of the nucleic acid fiber 310, whereby each end of nucleic acid fiber 310 binds to its complementary oligonucleotide in one of linkers 306 and 308 to form a bridge 312 between the two electrodes 300 (step (b)). By controlling the concentration of oligonucleotide 310 in the medium, the number of such bridges formed between the electrodes can be controlled. Following hybridization the binding of the linkers to the nucleic acid fibers may be strengthened by covalent binding of the two to one another by ligation of the nicks.

Please replace the paragraph beginning at page 25, line 12, with the following amended paragraph.

The functionalization step of the fiber, for the purpose of constructing a metal wire, begins, according to the specifically illustrated embodiment as shown in Fig. 3B, by an ion exchange step involving exposure of the fiber to a solution comprising silver ions (Ag^+) under alkaline conditions, whereby the silver ions replace the sodium ions or other ions normally associated with the nucleotide chain and complex with the negatively charged fibers (step (c)). This gives rise to a nucleic acid fiber 314 loaded with silver ions 316. It should be

noted, that rather than silver ions, a wide variety of other metal ions can be used, including for example, cobalt, copper, nickel, iron, gold, etc. Furthermore, metal aggregates, complexes or clusters, e.g. colloidal gold, colloidal silver, etc., may also be deposited on the nucleic acid fiber via a variety of different interactions. The ion-exchange step typically involves rinsing of the fibers with deionized water, and then soaking them in a solution of the metal ions or metal aggregates.

Please replace the paragraph beginning at page 26, line 16, with the following amended paragraph.

~~Fig. 3B~~ Fig. 3C illustrates a typical current-voltage relationship of a wire formed by the procedure illustrated in ~~Fig. 3A~~ Figs. 3A-3B. As can be seen, the curves are non linear and are asymmetric with respect to zero bias. The shapes of the curves depend on the scan direction as indicated by the arrows in ~~Fig. 3A~~ Fig. 3C. Approaching zero voltage from a large positive or negative bias, the current vanishes almost linearly with the voltage. A zero current plateau then develops with very large differential resistance. At a higher bias, the wire turns conductive again with a different channel resistance. This history-dependent current-voltage relationship, may render the wire as a logic or memory component.

Please replace the section beginning at page 27, line 1 and ending at page 27, line 22, with the following amended section.

Reference is now being made to ~~Fig. 4~~ Figs. 4A-4B, showing the manner of formation of a wire in accordance with another embodiment of the invention. Here again the wire is formed on a nucleotide skeleton. As pointed out above, with reference to the embodiment of ~~Fig. 3A~~ Figs. 3A-3B, a similar procedure, *mutatis mutandis* may be followed with respect to a fiber of the kind shown in Fig. 8A. In ~~this~~ the embodiment shown in Fig. 4A, in distinction from that of Fig. 3A, rather than metal, the deposited material is PPV (poly-phenylene vinylene). Electrodes **400**, may be the same as electrodes **300** shown in ~~Fig. 3~~ Fig. 3A. The first two steps of the method (steps (a) and (b)), are substantially identical to the corresponding steps in Fig. 3A (identical components have been given a reference numeral with the same last two digits as the corresponding components in Fig. 3A: e.g. **402** is the same as **302**, **404** as **304**, etc.). The formed bridge **412** may be strengthened, similarly as above, by covalent binding of fiber **410** to linkers **406** and **408** to yield a complete fiber **414** connecting the two electrodes (step (c)).

[[A]] As shown in Fig. 4B, a solution comprising pre-PPV⁽²⁶⁾ molecules **416** is then contacted with fiber **414** and by the virtue of being positively charged, pre-PPV **414** becomes complexed with the negatively charged DNA bridge **414** (step (d)). At a next step, the sample is rinsed, dried and finally heated in a vacuum, e.g. to a temperature of about 300°C, for about 6 hours, which leads to the release of tetrahydrothiophene groups and hydrochloric acid from each repeat unit, yielding a luminescent PPV component (step (e)).

Please replace the section beginning at page 28, line 20 and ending at page 29, line 11, with the following amended paragraphs.

An example of some functional components which may be formed on a nucleotide chain are shown in ~~Fig. 5~~ Figs. 5A-5E. In Fig. 5A, a p/n junction is formed by a p-type substance **510** bound to one oligonucleotide **512**, which is a poly C in this specific example, and an n-type substance **514** bound to another oligonucleotide sequence **516**, a poly A in this specific example. The oligonucleotides bind to complementary sequences **518** and **520**, respectively, on the nucleotide fiber **522** and after coupling, a p/n junction is formed. In Fig. 5A, the p/n junction is formed on a single-stranded segment of fiber **522**. Similarly, such a junction may also be formed on a double-stranded fiber **524** (see Fig. 5B), e.g. by first removing a portion of one strand, e.g. by enzymatic digestion to expose adjacent segments **526** and **528** and then hybridization with the complementary p-type and n-type substance-carrying oligonucleotides **530** and **532**, respectively.

The remaining portion of the fiber, may, for example, be treated in a manner to fabricate a wire, such as that described above with reference to Figs. ~~3 or 4~~ 3A-3B or 4A-4B, and accordingly a diode (a p/n junction) **534** is formed with conducting wires (C) **536** and **538** flanking the two ends of the diode (Fig. 5C). In order to ensure that the conductor substance is not deposited on the p-n junction portion, the materials constituting the junction may first be coupled and only then the remaining portion of the fiber may be treated in a manner described above to form a conducting wire.

Please replace the paragraph beginning at page 30, line 1, with the following amended paragraph.

p-n junctions may also be obtained in accordance with the invention in fibers of the kind illustrated in Fig. 8A, which consists of nucleotide chains attached to non-nucleotide fiber stretches made of a semi-conducting polymer. Where the semi-conducting

polymer is a p-type, an n-type polymer may be deposited on the nucleotide chain segment adjacent the semiconductor fiber segment in an analogous manner to that shown in ~~Fig. 5~~ Figs. 5A-5E. Similarly, a p-n junction may be found by depositing a p-type polymer on a nucleotide chain segment adjacent an n-type semiconductor fiber sequence.

Please replace the paragraph beginning at page 31, line 16, with the following amended paragraph.

Reference is now being made to ~~Fig. 7~~ Figs. 7A-7B, illustrating a molecular switch which is based on a reversible photo transformation. A molecular fragment, such as bis thiophene derivatives of hexafluorocyclopentene or maleimide, (Figs. 7A and 7B, respectively), are bound to the networks. Polymer groups (P1 and P2 (which may be the same or different)) that may contain recognition groups which may be sequence selective or non sequence selective, are attached to both thiophene moieties via covalent or non covalent interaction to form a disrupted conjugated polymer. The polymers P1 and P2 are each connected to a different fiber (P1 and P2, respectively -not shown). Upon exposure to light with an appropriate wavelength (λ), photocyclization of the thiophenes with a double bond of the hexafluorocyclopentene or maleimide occurs, thus forming a conjugated polymeric wire electrically linking P1 and P2. Photo excitation of the cyclized switch results in the retrocyclization process and redisrupts the conjugation along the polymer.

Please replace the paragraph beginning at page 32, line 3, with the following amended paragraph.

Fig. 8A illustrates schematically other embodiments of fibers in accordance with the invention: whereas the fibers shown above in ~~Figs. 3A and 4~~ 3A-3B and 4A-4B, had a nucleotide skeleton, the fibers shown in Fig. 8A have a skeleton which is a composite structure consisting of both nucleotide segments and non-nucleotide segments. Fig. 8A shows two embodiments of fibers, fiber 700 and fiber 710. Fiber 700 has, as a major portion, a non-nucleotide fiber stretch 702 whose terminals are linked to two nucleotide chains 704 and 706. Non-nucleotide fiber stretch 702 may be a polymer, conducting, semi-conducting, or non-conducting, or may be a nano-tube, e.g. a carbon-based nano-tube.

Please replace the paragraph beginning at page 33, line 18, with the following amended paragraph.

~~Fig. 12 is a~~ Figs. 12A-12B are schematic illustrations of a FET in accordance with the invention. The FET 800 comprises source electrode 802, a drain electrode 804, situated at two ends of a semiconductor matrix 806. Gate wire 808, connected to gate electrode 810, is situated in a recess 812, within semiconductor matrix 806. The gate length in a semiconductor FET determines, to a large extent, the maximal frequency at which the FET can operate. Shorter gates minimize the electron flight time under the gate and hence facilitate higher operation frequencies. Since FET dimensions, apart from the gate, are not critical, the gate parameters set the bottle neck for mass production of faster FETS. The FET in accordance with the invention provides a solution to this problem. The FET, apart from the gate, may be fabricated by conventional lithography and semiconductor processes and techniques, and then the gate may be formed by stretching a nucleic acid fiber between electrodes and then the fiber may be metalized as outlined above. In this manner sub-0.1 micrometer gates can easily be formed allowing inexpensive mass production of faster FETS.

Please replace the paragraph beginning at page 34, line 19, with the following amended paragraph.

Biotin moiety is attached to an oligonucleotide having a specific sequence, as known *per se*. The biotin-oligonucleotide is coupled via a streptavidin molecule to another molecule containing a biotin moiety at one side (see also ~~Fig. 1B~~ Fig. 1C) and a thiol or disulfide group on the other side.

Please replace the paragraph beginning at page 44, line 11, with the following amended paragraph.

~~Figure 3A outlines~~ Figs. 3A-3B outline the DNA templated assembly of a metal wire. A glass coverslip was first passivated against spurious DNA binding. Subsequently, two parallel gold electrodes were deposited on the coverslip using standard microelectronic techniques. One gold electrode was then wetted with a micron size droplet of an aqueous solution containing a 12-base, specific sequence oligonucleotide, derivatized with a disulfide group attached to its 3' side. Similarly, the second electrode was marked with a different oligonucleotide sequence. After rinsing, the sample was covered by a solution of about 16 μm long λ -DNA, having two 12-base sticky ends that were complementary to the oligonucleotides attached to the gold electrodes. A flow normal to the electrodes was induced to stretch the DNA, allowing its hybridization with the two distance

surface-bound oligonucleotides. Stretching the DNA between two electrodes could also be carried out in reverse order, where hybridization and ligation of the disulfide derivatized oligonucleotides to the long DNA molecule was performed prior to its application to the sample. Both methods work equally well. Fig. 14 depicts a fluorescently-labeled λ -DNA bridging two gold electrodes. By observing the curving of the DNA molecule under perpendicular flow it was demonstrated that it was attached solely to the electrodes. Sample preparation was completed by removal of the solutions.